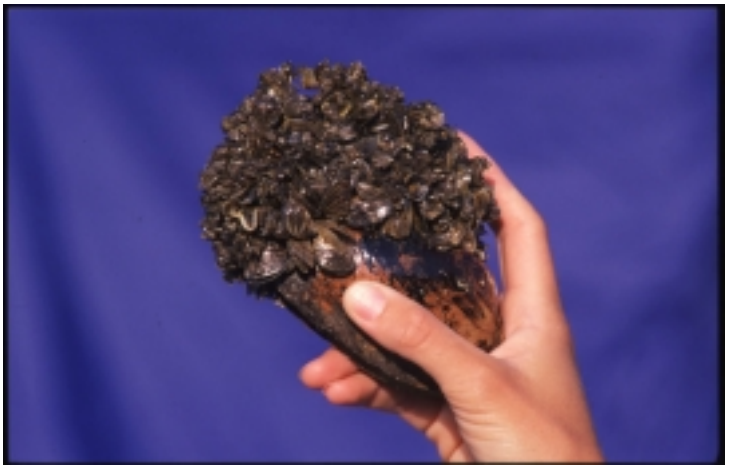
Lake Huron's New Ecosystem and Foodweb

The ecosystem of Lake Huron has undergone fundamental change since about 1992. Beginning in the late 1990s these changes began to manifest themselves in the quality and character of the lake's valuable recreational and commercial fisheries. The ecosystem changes were driven (principally) by 3 evidently permanent changes in the foodweb:

1. Colonization by new invasive species: Zebra and quagga mussels have trapped much of the lake's productivity into mussel colony "sinks", where high biomass has accumulated that is not efficiently channeled to the rest of the food chain. Mussel colonies appear to have affected fish productivity of the nearshore area out to depths of about 150 feet, which used to be the lake's most productive zone for fisheries.



Zebra mussels

Biologists are alarmed at the decline and near disappearance of a crustacean called Diporeia. This shrimp-like animal feeds on plankton that settles to the bottom. Diporeia migrate off the bottom at night making them especially available as prey for fish such as alewives and whitefish. Diporeia thus acted as a mechanism for recycling settled nutrients back into the midwater foodchain, enhancing production of species such as alewives and Chinook salmon. Although the mechanism for the collapse of Diporeia is not clear, their demise came closely on the heels of the zebra and quagga mussel invasions.

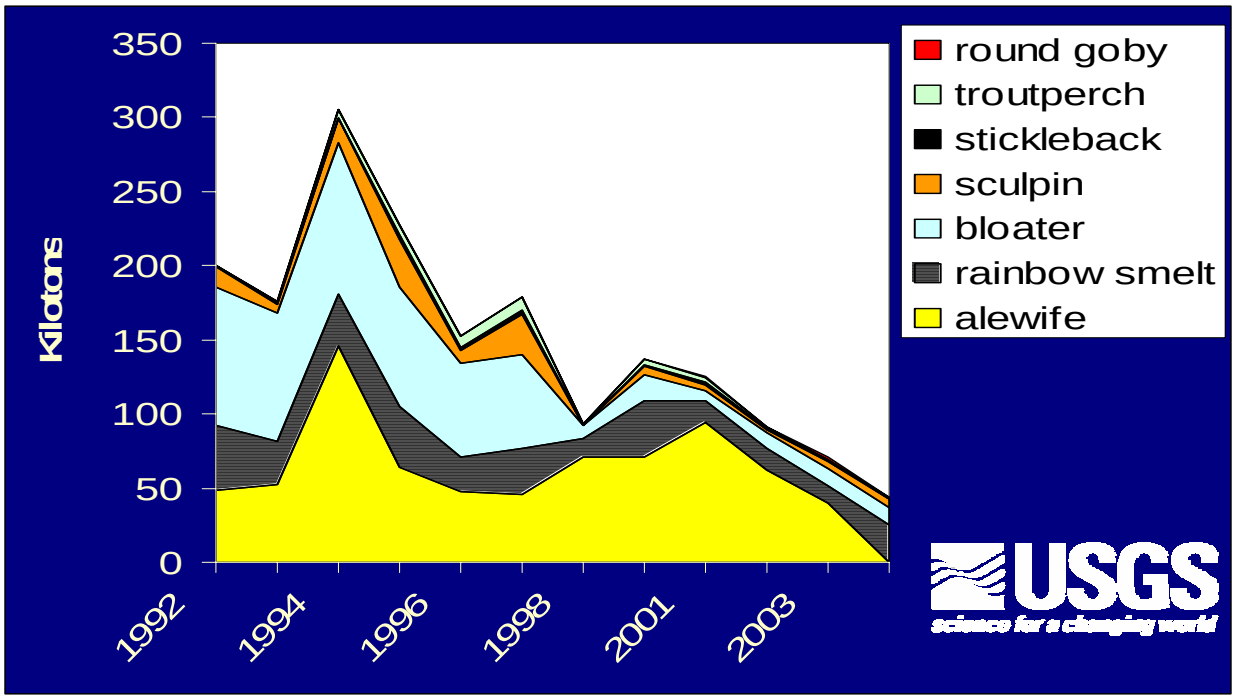
Diporeia: This species has almost disappeared since the invasion of zebra and quagga mussels. Diporeia once were a major prey item for alewives and lake whitefish. Photo courtesy of NOAA

2. Reproduction of Chinook salmon rose sharply after 1995. A current study of reveals that approximately 80% of Lake Huron's Chinook born in 2000, 2001, 2002, and 2003 were wild. Survival of hatchery Chinooks declined sharply as reproduction rose. Thus, most Chinook caught from Lake Huron in recent years are wild. Most Chinook reproduction is in Ontario's tributaries to Georgian Bay and North Channel. Consequently, as Chinook mature they tend to leave Michigan waters in late summer to spawn in their natal streams in Ontario.

3. As a result of the above factors, alewives, which had been the chief prey of Chinook salmon in the 1990s, have nearly disappeared. Alewives were caught in a squeeze between lower availability of nutrients caused by the mussel colony "nutrient trap" and elevated predation rates caused by high reproduction rates in Chinook salmon.

   Rainbow smelt were Lake Huron's chief preyfish until the late 1980s, when alewives became dominant. Alewives appeared to be very stabile until 1997, when they nearly collapsed. They recovered rapidly in 1998 and 1999, thanks to two very mild winters, but collapsed completely in 2004.

Prey fish Biomass, by Species, Fall Bottom Trawl



There were other factors involved. For example, alewife survival was mediated by winter severity, which varied widely the past 8 years. Lake trout are surviving much better as a result of more effective sea lamprey control and provisions of the 2000 Consent Decree regarding tribal fishing rights in northern Lake Huron. Thus, predation rates from lake trout have also risen. However, these are the 3 leading factors that precipitated the changes anglers are now, or soon will be, witnessing.

The new ecosystem:

Change is never welcome when prevailing conditions are satisfactory. Until 2003; Chinook salmon success rates (fish harvested per angler day) on Lake Huron were highest of any of Michigan's Great Lakes. Now, with the near disappearance of alewives, we are seeing the following new conditions:

1. Chinook catch rates have dropped to below their long-term average and below those of Lake Michigan; the decline has been especially pronounced in Lake Huron south of Alpena.
2. Chinook condition (plumpness) is the lowest ever measured in Great Lakes salmon. Three-year-old salmon that once averaged over 14.3 pounds averaged only 8.1 pounds in 2004. Some fish are visibly emaciated. A similar decline in Chinook weights occurred in 1998, when alewife numbers declined and 3-year-old Chinook weights dropped to 9.5 pounds. Stocking was reduced 20%. Chinook weights recovered sharply due to a rapid rebound in alewife numbers. The collapse of alewives in 2004 means that recovery of Chinooks and their prey will be much slower this time.
3. Lake trout catch rates have soared to the highest ever seen in Lake Huron, while lake trout condition has declined. In 2004 lake trout replaced Chinook salmon as the lead salmonid harvested by anglers in Michigan's waters of Lake Huron. The rise in the lake trout fishery is attributed to their rise in numbers following the successful treatment of sea lampreys in the St. Marys River, and harvest controls provided by the 2000 Consent Decree, combined with higher vulnerability to angling. Lake trout are easier to catch when they are hungry: they spend more time feeding and are more likely to hit a lure when their food supply is low. Although lake trout growth rates have declined with the alewife collapse, they remain healthy and are not showing signs of emaciation. They appear to be adapting well to new prey sources.
4. Whitefish (Lake Huron's lead commercial fish) condition factors are very low, causing a reduction in their marketability and price per pound. The decline in whitefish growth and condition is almost certainly caused by the disappearance of Diporeia, which for eons had been the preferred prey of lake whitefish.
5. Native species have begun reproducing at the highest rates measured since at least 1970. Alewives appear to have been suppressing reproduction of native species. The recent rise in native fish reproduction is thought to be largely due to the alewife collapse. There are two theories of how alewives suppressed native species: 1) diets of alewives caused lethal deficiencies of thiamine, and 2) adult alewives preyed on the young of other species. A recovery of native predators such as lake trout and walleyes, added to the effects of Chinook reproduction, would act to further increase predation pressure on the beleaguered alewife population, which could in turn ensure future reproduction of native species.

   Yellow perch have been one of Lake Huron's most sought after game fish. Unfortunately, perch numbers in the Main Basin of Lake Huron declined to a record low point in 2004. A recovery of yellow perch now seems possible, perhaps likely. If reproduction continues at the 2003 and 2004 pace, and if the young perch survive four or five years to become a desirable size, there could be a strong resurgence of interest in perch fishing. Recoveries of traditionally important perch fisheries, such as those of Les Cheneaux Islands, Tawas, Pt. Austin, Harbor Beach, Port Sanilac, and Lexington, would likely attract increased

in fishing pressure and stimulate industries (motels, restraints, tackle stores) related to the recreational fishery in these communities. This, in turn, could offset reduced production of Chinook salmon.

What's it all mean?

It appears that midwater food supplies are the most affected by exotic mussel colonization of Lake Huron. Chinook salmon are obligate pelagic (midwater) feeders: they feed almost exclusively in the midwater zone rather than the bottom; thus Chinook salmon are among the more vulnerable elements to the effects of mussel colonization. Lake trout and walleyes, on the other hand, are more opportunistic feeders and appear to be adapting to the new food web. The round goby, another recent invader which lives in association with mussel colonies, frequently appear in the diets of these two species, but almost never in Chinook salmon. Lake whitefish once fed heavily on Diporeia. There is much uncertainty regarding whether Diporeia will recover and how lake whitefish will fare in the absence of Diporeia.

Rising reproduction rates of salmon, walleyes, and perhaps lake trout may mean that Lake Huron will become much less dependant on hatchery supplementation than in the past, which is consistent with the interagency Fish Community Goals set for Lake Huron. A less hatchery-dependent system will be significantly less costly to manage but will be more likely to produce "surprises". The lake's users will need to adapt to what the lake "chooses" to offer, rather than to what the DNR chooses to stock. Agencies will be less successful in molding the lake to their wishes than in the past. For example, no amount of stocking or other management is likely to bring back the kind of Chinook production Lake Huron was known for if the open water food supply remains suppressed. In fact, stocking of Chinook salmon in Lake Huron appears not to be contributing much to the recreational fishery, except in the fall, when Chinook in spawning condition return to stocking sites.

While open water production has declined, it appears that rising Chinook predation has suppressed alewives to the point that a niche, albeit a smaller one, for open water prey fish has opened. Nature hates a vacuum and there now appears to be one in the wake of the alewife collapse. There are several ways the future could play out to fill the alewife niche.

1. Alewives could experience more favorable conditions in the form of some combination of declining predation and mild winters and stage a recovery. Chinook might recover in turn and a cyclic pattern of predator and prey abundance evolves. During periods of low alewife abundance, Chinook would decline, but other species should experience high reproduction levels. During high alewife abundance, Chinook would rebound and reproduction of other species mightdecline.
2. Alewives remain present but never regain dominance. In this scenario, rainbow smelt and the native lake herring become more abundant and share dominance. Lake trout and walleye become self sustaining and salmon play a secondary role. This is the condition that evolved as Lake Superior's predator fish recovered from near extinction. Lake herring are currently absent in Lake Huron's Saginaw Bay and Thunder Bay, which once were population centers for this species. Reintroduction of lake herring to these locations is a management option under consideration.

3. The alewife niche is filled by some other species, perhaps another invasive which has been waiting in the wings for this opportunity. Great Lakes ecosystems are complex and respond to change in unpredictable ways, particularly with their vulnerability to invasive species invasions. There will almost certainly be some elements of surprise in whatever the future holds for Lake Huron.

The Fishery Division, in concert with Michigan State University Sea Grant and local angling organizations, is hosting meetings along the Lake Huron shore during April. The workshops are an effort to share this information with the public and to engage them in the process of thinking about management changes necessary to adapt to these new conditions.